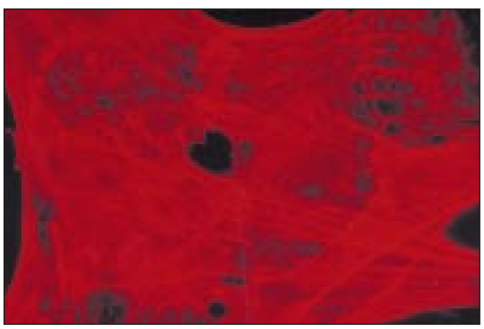
STS-95

BioDyn: Working to Take Space Biomedicine Into the 21st Century

Biomedical research offers hope for a variety of medical problems, from diabetes to the replacement of damaged bone and tissues. Bioreactors, which are used to grow cells and tissue cultures, play a major role in such research and production efforts. STS-95 features a commercial bioreactor for space-based investigations of commercial applications.



Courtesy: UAH

Cell culturing, such as this bone cell culture, is an important part of biomedical research.

The entirely automated BioDyn Bioreactor combines a rotating culture vessel with the ability to collect up to six samples during operation. This represents a significant step toward completely automated operations for the University of Alabama in Huntsville's (UAH's) commercial industry-affiliated cell culture products on the International Space Station (ISS). On STS-95, four major product lines will be supported within the BioDyn project, with one utilizing the BioDyn Bioreactor.

Recombinant proteins may offer the possibility of reducing or eliminating transplant rejections. Research by Synthecon, Inc., using the BioDyn Bioreactor, will focus on the preliminary process for growing a proprietary recombinant protein that can decrease rejection of transplanted tissue. The cells producing this protein are

Anchorage-dependent cells on STS-95 will be grown on beads, similar to these cells produced during previous investigations.

Courtesy: UAH

anchorage dependent, meaning that they must attach to something to grow. These cells will be cultured in the bioreactor in a medium containing polymer microbeads. Synthecon hopes that the data from this mission will lead to the development of a commercial protein that will aid in prevention of transplant rejection.

Another protein product of commercial interest to Synthecon is a protein which programs cells to die, as a part of the normal life cycle. The proteins that regulate this cell death are the target of Synthecon's cell aging investigation, which hopes to use the knowledge to develop proteins for remediation for a variety of geriatric diseases that result from a decline in immune system function.

Microencapsulation provides the ability to place treatments exactly where needed, offering the opportunity for improving the treatment of diseases such as diabetes. The BioDyn project will be helping investigate this powerful technology with an experiment developed by VivoRx, Inc., of Santa Monica, California, that focuses on improving the microencapsulating material for the cells that produce insulin in the human body. The improved microencapsulation material and information from this experiment could lead to an implantable treatment for diabetes and avoid the need for daily insulin injections.

In addition, the BioDyn payload includes a tissue engineering investigation. The commercial affiliate, Millenium Biologix, Inc., has been conducting bone implant experiments to better understand how synthetic bone can be used to treat bone-related illnesses and bone damaged in accidents. On STS-95, the BioDyn payload will include a bone cell culture aimed to help develop this commercial synthetic bone product. Millenium Biologix, Inc., is exploring the potential for making human bone implantable materials by seeding its proprietary artificial scaffold material with human bone cells. The product of this tissue engineering experiment using the Bioprocessing Modules (BPMs) on STS-95 is space-grown bone implants, which could have potential for dental implants, long bone grafts, and coatings for orthopedic implants such as hip replacements. Another aspect of the tissue engineering program is aimed at eventual development of “heart patches” (cardiomyocytes tissue) to replace damaged heart muscle. On STS-80, researchers from the University of South Carolina (USC), using the BioDyn BPM hardware, achieved multilayered patches not achieved in the ground-based process. On STS-95 the heart patch experiment will be flown in the UAH BPMs to test the validity of achieving patches in the centimeter rather than millimeter size range. Based on their positive results from two previous BioDyn payload experiments, researchers at USC have submitted a patent disclosure for the “heart patch” process in space and are discussing commercial development with potential commercial affiliates, Genzyme, Inc., and Organogenesis, Inc.

The final area of exploration on the BioDyn payload is production of anticancer drugs from plant cells cultured in the BPMs. Hauser Chemical, a Colorado company, is interested in anticancer compounds derived from soybean cells in culture and will fly the experiment in the BPMs in collaboration with researchers at the University of Michigan.

The BioDyn Bioreactor is a joint effort among Synthecon, Inc., of Houston, Texas, which holds the licenses to rotating bioreactor technology, Space Hardware Optimization Technology (SHOT), Inc., who built the hardware, and the Consortium for Materials Development in Space (CMDS), the NASA Commercial Space Center located at UAH, who provided both technical and research expertise. In addition to the bioreactor, the Biodynamics and Space Cell Culture (BioDyn) payload consists of 13 crew-operated BPMs, assembled by UAH and flown by UAH on five previous shuttle missions, and an Automated Bioprocessing Module (ABPM) designed and developed at UAH.

Since STS-95 will be the first flight of a BioDyn Bioreactor and of an ABPM, data on the operational performance in microgravity will be a valuable result of the mission. These results will eventually be used to fine-tune the design of similar research hardware for use on the ISS.

Consortium for Materials Development in Space
Charles Lundquist, Director
Huntsville, Alabama

National Aeronautics and Space Administration

George C. Marshall Space Flight Center
Huntsville, Alabama

FS-1998-09-53-MSFC